

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application. An identifier indicating the status of each claim is provided.

Listing of Claims

1-4. (Canceled)

5. (Currently Amended) A method according to ~~claim 4~~ claim 67 wherein

$$\alpha = (\alpha' + \text{offset})$$

where $\alpha' + \text{offset}$ is a function of the data bit to be embedded in the coefficient,

$\alpha' = 0$ if S is positive and the data to be ~~encoded~~ embedded is a symbol of a first value,

$\alpha' = 0$ if S is negative and the data to be ~~encoded~~ embedded is a symbol of a second value, and

otherwise α' is a function of S such that $\sum C_i' P_i$ has the correct sign to represent the symbol to be ~~encoded~~ embedded.

6. (Original) A method according to claim 5, wherein

the first value is "1" and the second value is "0".

7. (Currently Amended) A method according to ~~claim 4~~ claim 5, wherein

the said function of S is $\alpha' = -S/(L-1)$ or $\alpha' = -S/L$.

8. (Currently Amended) A method according to ~~claim 4~~ claim 5, wherein the magnitude of the offset is greater than or equal to zero.
9. (Original) A method according to claim 8, wherein the magnitude of the offset is one.
10. (Currently Amended) A method according to ~~claim 4~~ claim 67, wherein the said coefficients are coefficients of a wavelet transform of the ~~material~~ information signal.
11. (Currently Amended) A method according to ~~claim 4~~ claim 67, wherein the data to be embedded includes a ~~UMID~~ Unique Material Identifier (UMID).
12. (Currently Amended) A method of removing data from an information signal representing material, which data has been embedded by the method of ~~claim 4~~ claim 67, the method comprising the steps of:
- calculating the correlation $S' = \sum C_i' * P_i$ for $i=1$ to L , where P_i are the bits of the ~~PRSS~~ Pseudo Random Symbol Sequence (PRSS) and have values +1 and -1;
- calculating α_r as a function of S' ; and
- calculating $C_i = C_i' - \alpha_r \cdot P_i$ to recover the unmodified coefficients C_i .
13. (Original) A method according to claim 12, wherein $\alpha_r = S'/(L-1)$ or $\alpha_r = (S'/L)$.

14. (Currently Amended) A method according to claim 12, further comprising the step of:

deriving the symbols of the ~~concealed~~ embedded data from S', where if S' is positive a symbol is of the first value and if S' is negative a symbol is of the second value.

15. (Currently Amended) A method according to claim 12, further comprising the step of:

generating and synchronizing a reference pseudo random symbol sequence with the pseudo random symbol sequence of the embedded data.

16. (Currently Amended) A computer program product embodied in a computer readable medium arranged to carry out the method of ~~claim 1~~ claim 67, when run on a computer.

17-20. (Canceled)

21. (Currently Amended) Apparatus according to ~~claim 20~~ claim 68 wherein

$$\alpha = (\alpha' + \text{offset})$$

where $\alpha' + \text{offset}$ is a function of the data bit to be embedded in the coefficient,
and the apparatus is arranged to

calculate modified coefficient values $C_i' = C_i + (\alpha' + \text{offset}) * P_i$ where

$\alpha' = 0$ if S is positive and the data to be ~~concealed~~ embedded is a bit of a first value,

$\alpha'=0$ if S is negative and the data to be ~~encoded~~ embedded is a bit of a second value, and

otherwise α' is a function of S such that $\sum C_i' \cdot P_i$ has the correct sign to represent the bit to be ~~encoded~~ embedded.

22. (Original) Apparatus according to claim 21, wherein the first value is "1" and the second value is "0".

23. (Original) Apparatus according to claim 21, wherein $\alpha = -S/(L-1)$ or $-S/L$.

24. (Currently Amended) Apparatus according to ~~claim 20~~ claim 21, wherein the offset is greater than or equal to zero.

25. (Currently Amended) Apparatus according to ~~claim 25~~ claim 24 wherein the offset = 1.

26. (Currently Amended) Apparatus according to ~~claim 20~~ claim 68, wherein the coefficients are coefficients of a wavelet transform of the ~~material~~ information signal.

27. (Currently Amended) Apparatus according to ~~claim 20~~ claim 68, further comprising:
a generator for generating a ~~UMID~~ Unique Material Identifier (UMID) as ~~the~~ said data to be embedded.

28. (Currently Amended) Apparatus for removing data from an information signal representing material, which data has been embedded by the apparatus of ~~claim 20~~ claim 68, the apparatus comprising:

a generator for generating a ~~PRSS~~ Pseudo Random Symbol Sequence (PRSS); and
a calculator for calculating,
the correlation $S' = \sum C_i' \cdot P_i$ for $i = 1$ to L where P_i are the bits of the PRSS,
a value α_r , dependent on S' , and
a coefficient value $C_i = C_i' - \alpha_r \cdot P_i$ to recover the unmodified coefficients C_i .

29. (Original) Apparatus according to claim 26, wherein $\alpha_r = S/(L-1)$ or (S/L) .

30. (Currently Amended) Apparatus according to claim 28, further comprising:
a decoder for deriving the bits of the ~~concealed~~ embedded data from the correlation value S' , where if S' is positive a bit of the data has a first value and if S' is negative a bit of the data has a second value.

31. (Currently Amended) Apparatus according to claim 28, further comprising a synchronizer for synchronizing the generated PRSS Pseudo Random Symbol Sequence (PRSS) with the PRSS of the embedded data.

32. (Currently Amended) A method of embedding data in an information signal representing material, said method comprising the steps of:

producing transform coefficients C_i of the material;

comparing the magnitudes of the coefficients with a threshold value T ; and

producing, from the coefficients C_i and ~~the~~ said data, modified coefficient values C_i' which are modified by respective information symbols of a pseudo random symbol sequence modulated by ~~the~~ said data to be embedded;

wherein ~~the~~ said step of producing modified coefficient values does not use coefficients of magnitude greater than ~~the~~ said threshold T and does not use the corresponding information symbols, the value of said threshold T being set to reduce a likelihood of any coefficient having a dominant effect on a correlation of the pseudo random symbol sequence and the information signal in which the data has been embedded.

33. (Original) A method according to claim 32, wherein the modified coefficients $C_i' = C_i + \alpha \cdot P_i$ where $\alpha \cdot P_i$ is an information symbol modulated by the data to be embedded, α being a scaling factor.

34. (Original) A method according to claim 33, wherein α is dependent on the data.

35. (Original) A method according to claim 33, wherein α is of fixed value.

36. (Original) A method according to claim 32, wherein
the modified coefficients $C_i' = C_i + \alpha \cdot R_i$
where R_i is an information symbol P_i modulated by the data, and α is a scaling factor.

37. (Currently Amended) A method according to claim 32, wherein
the said transform is a wavelet transform.

38. (Currently Amended) A method according to claim 32, wherein
the said transform is a spatial frequency transform.

39. (Currently Amended) A method for detecting data embedded in an information signal representing material, the detecting method comprising:
receiving transform coefficients of the ~~material~~ information signal;
comparing the magnitudes of the received coefficients with a threshold value T ; and
correlating, the said coefficients with a respective symbols of a pseudo random symbol sequence to detect the said data,

wherein the correlating step does not use coefficients of magnitude greater than ~~the~~ said threshold T and corresponding symbols of the pseudo random symbol sequence.

40. (Currently Amended) A method according to claim 39, further comprising the step of:

removing ~~the~~ said data from ~~the~~ said received coefficients not using coefficients of magnitude greater than said threshold T.

41. (Currently Amended) A method of detecting data embedded in an information signal representing material, the method comprising~~[[;]]~~ the steps of:

receiving transform coefficients of the ~~material~~, information signal;

comparing the magnitudes of the received coefficients with a threshold Tclip;

clipping, to a magnitude Tclip, the magnitude of coefficients of magnitude greater than ~~the~~ said threshold Tclip; and

correlating the clipped and unclipped coefficients with a pseudo random symbol sequence to detect data embedded in the ~~material~~ information signal.

42. (Currently Amended) A method according to claim 41, further comprising the step of:

composing removing data from said clipped and unclipped coefficients.

43. (Currently Amended) A method of embedding data in an information signal representing material, said method comprising the steps of:

producing transform coefficients C_i of the material;
comparing the magnitudes of the coefficients with a threshold value T ; and
producing, from the coefficients C_i and the said data, modified coefficient values C_i' which are modified by respective information symbols of a pseudo random symbol sequence modulated by the said data to be embedded;
wherein the said step of producing modified coefficient values does not use coefficients of magnitude greater than the said threshold T and does not use the corresponding information symbols; and detecting the data by
receiving transform coefficients of the material;
comparing the magnitudes of the received coefficients with a threshold T_{clip} ;
clipping, to a magnitude T_{clip} , the magnitude of coefficients of magnitude greater than the said threshold T_{clip} ; and
correlating the clipped and unclipped coefficients with a pseudo random symbol sequence to detect data embedded in the material.

44. (Currently Amended) A method of embedding data in an information signal representing material, the method comprising the steps of:
receiving transform coefficients C_i representing the ~~material~~ information signal;
comparing the magnitudes of ~~the~~ said transform coefficients C_i with a threshold T_{clip} ;
clipping, to the magnitude T_{clip} , the magnitudes of those of the coefficients having a magnitude exceeding T_{clip} to produce clipped coefficients; and

producing modified coefficients C_i' values dependent on a scaling factor and the data to be embedded, and the scaling factor is calculated using ~~the~~ said clipped coefficients and the coefficients C_i of magnitude less than T_{clip} .

45. (Currently Amended) A computer program product embodied in a computer readable medium arranged to carry out the method of 32, when run on a computer.

46. (Currently Amended) Apparatus for embedding data in an information signal representing material, said apparatus comprising:

a transformer for producing transform coefficients C_i of the ~~material~~, information signal;

a comparator for comparing the magnitudes of the coefficients with a threshold value T ;

and

a combiner for producing, from the coefficients C_i and ~~the~~ said data, modified coefficient values C_i' which are modified by respective information symbols of a pseudo random symbol sequence modulated by ~~the~~ said data to be embedded,

wherein the combiner does not use coefficients of magnitude greater than ~~the~~ said threshold T and does not use the corresponding information symbols, the value of said threshold T being set to reduce a likelihood of any coefficient having a dominant effect on the correlation of the pseudo random symbol sequence and the information signal in which the data has been embedded.

47. (Original) Apparatus according to claim 46, wherein

the combiner is arranged to produce modified coefficients $C_i' = C_i + \alpha.P_i$

where αP_i is an information symbol modulated by the data to be embedded, α being a scaling factor.

48. (Original) Apparatus according to claim 47, wherein
 α is dependent on the data.

49. (Original) Apparatus according to claim 47, wherein
 α is of fixed value.

50. (Original) Apparatus according to claim 46, wherein
the combiner is arranged to produce coefficients $C_i' = C_i + \alpha R_i$
where R_i is an information symbol P_i modulated by the data, and α is a scaling factor.

51. (Currently Amended) Apparatus according to claim 50, said apparatus further
comprising:

a pseudo random sequence generator and a modulator for modulating the pseudo random
sequence with the said data.

52. (Currently Amended) Apparatus according to claim 46, wherein
the said transformer is a wavelet transformer.

53. (Currently Amended) Apparatus according to claim 46, wherein the said transformer produces a spatial frequency transform of ~~the said material~~ information signal.

54. (Currently Amended) Apparatus for detecting data embedded in an information signal representing material, the detecting apparatus comprising:

an input for receiving transform coefficients of ~~the material~~ an information signal;
a comparator for comparing the magnitudes of the received coefficients with a threshold T; and
a correlator for correlating ~~the~~ said coefficients with respective symbols of a pseudo random symbol sequence to detect ~~the~~ said data,
wherein the correlation does not use coefficients of magnitude greater than the said threshold T and the corresponding symbols of the pseudo random symbol sequence.

55. (Currently Amended) Apparatus according to claim 54, further comprising:
a data remover for removing data from the receiving coefficients, the remover omitting coefficients of magnitude greater than ~~the~~ said threshold T.

56. (Currently Amended) Apparatus for detecting data embedded in an information signal representing material, said apparatus comprising[:]:

an input for receiving transform coefficients C_i' of the ~~material~~ information signal;
a comparator for comparing the magnitudes of the received coefficients with a threshold T_{clip} ;

a clipper for clipping, to a magnitude T_{clip} , the magnitude of coefficients of magnitude greater than ~~the~~ said threshold T ; and

a correlator for correlating the clipped and unclipped coefficients with a pseudo random symbol sequence to detect data embedded in the ~~material~~ information signal.

57. (Currently Amended) Apparatus according to claim 56, further comprising:

a remover for removing data from the clipped and unclipped coefficients.

58. (Currently Amended) Apparatus for embedding data in an information signal representing material, the apparatus comprising:

an input for receiving transform coefficients C_i representing the ~~material~~ information signal;

a comparator for comparing the magnitudes of ~~the~~ said transform coefficients with a threshold T_{clip} ;

a clipper for clipping, to the magnitude T_{clip} , the magnitudes of those of the coefficients having a magnitude exceeding T_{clip} ; and

a processor for producing modified coefficients C_i' values dependent on a scaling factor and the data to be embedded, and the scaling factor is calculated using ~~the~~ said clipped coefficients and the coefficients C_i of magnitude less than T_{clip} .

59. (Currently Amended) A system including an embedding apparatus, said system comprising:

a transformer for producing transform coefficients C_i of ~~the~~ an information signal representing material,

a comparator for comparing the magnitudes of the coefficients with a threshold value T ,
and

a combiner for producing, from the coefficients C_i and the said data, modified coefficient values C_i' which are modified by respective information symbols of a pseudo random symbol sequence modulated by the said data to be embedded, wherein the combiner does not use coefficients of magnitude greater than the said threshold T and does not use the corresponding information symbols; and detecting apparatus comprising:

an input for receiving transform coefficients of the material;

a comparator for comparing the magnitudes of the received coefficients with a threshold T ; and

a correlator for correlating the said coefficients with respective symbols of a pseudo random symbol sequence to detect the said data, wherein the correlation does not use coefficients of magnitude greater than the said threshold T and the corresponding symbols of the pseudo random symbol sequence.

60. (Currently Amended) A method according to claim 32, wherein

~~the~~ said data comprises a ~~UMID~~ Unique Material Identifier.

61. (Currently Amended) A method according to claim 32, wherein
~~the~~ said material comprises video material
62. (Currently Amended) A method according to claim 32, wherein
~~the~~ said material comprises audio material.
63. (Currently Amended) A computer program product embodied in a computer readable medium arranged to carry out the method of ~~claim 4~~ claim 67 when run on a computer.
64. (Currently Amended) A computer program product embodied in a computer readable medium arranged to carry out the method of claim 39 when run on a computer.
65. (Currently Amended) A computer program product embodied in a computer readable medium arranged to carry out the method of claim 41 when run on a computer.
66. (Currently Amended) A computer program product embodied in a computer readable medium arranged to carry out the method of claim 44 when run on a computer.
67. (New) A method of embedding data in an information signal representing material, the method comprising the steps of:
- producing transform coefficients C_i representing a transform of the information signal;
 - producing a pseudo random symbol stream having L symbols P_i , the pseudo random symbol stream comprising symbol values of +1 or -1;

calculating a correlation value $S = \sum C_i * P_i$ for $i = 1$ to L ; and

calculating modified coefficient values $C_i' = C_i + \alpha * P_i$, where α is calculated dependent on the value of S being positive or negative to identify a corresponding binary value of the data symbol being embedded.

68. (New) An apparatus for embedding data in an information signal representing material, the apparatus comprising:

a transformer for producing transform coefficients C_i representing a transform of the information signal;

a generator for producing a pseudo random symbol stream having L symbols P_i , the pseudo random symbol stream comprising symbol values of +1 or -1;

an input for receiving symbols of the data to be embedded; and

a data embedder arranged to calculate a correlation value $S = \sum C_i * P_i$ for $i = 1$ to L ; and

to calculate modified coefficient values $C_i' = C_i + \alpha * P_i$, where α is calculated dependent on the value of S being positive or negative to identify a corresponding binary value of the data symbol being embedded.